

## METHOD FOR SMOOTHING SUBSTRATE SURFACE

### CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is a continuation patent application of U.S. patent application Ser. No. 14/815,499, filed Jul. 31, 2015 and titled "Method for Smoothing Substrate Surface," the disclosure of which is hereby incorporated herein by reference in its entirety.

### FIELD

[0002] The described embodiments relate generally to methods for smoothing surfaces of substrates. More particularly, the present embodiments relate to creating mateable surfaces by depositing material in or around surface defects of substrates.

### BACKGROUND

[0003] Cutter marks, scratches, pits, dents or other surface defects are very common in the manufacturing of parts. Some of the surface defects are related to the handling of the parts during the manufacturing process. Some surface defects are related to the machining process itself. For example, a manufacturing tool and/or part can shift during a machining operation, causing unintended marks or inconsistencies on the surface of the part. Some surface defects are related to manufacturing tolerances that are inherent to the machining process. In some cases, certain materials, such as soft, malleable or brittle materials, can be especially susceptible to acquiring certain types of surface defects.

[0004] One of the problems associated with surface defects relates to the manufacture of mating components of a part. In particular, surface defects can cause uneven mating surfaces of matching parts. For example, a cutter tool can create divots or channel shaped defects that are sub-flush to surrounding surfaces. These divots or channels can prevent intimate contact between mating surfaces, which in turn can lead to formation of a noticeable gap between the mating components, adversely affecting the cosmetic appearance of the part. In addition, this can lead to poor sealing and poor adhesion of the mating components, which negatively affects the reliability and functionality of the part. These defects, if not repaired, may also be carried forward and cause processing problems or failures in later manufacturing stages.

### SUMMARY

[0005] This paper describes various embodiments that relate to manufacturing techniques for forming smooth mating surfaces on parts. In particular embodiments, non-contact additive processes, such as printing techniques or robot-controlled needle dispensing techniques, are used to precisely deposit material in and/or around surface defects so as to form consistently smooth surfaces for mating with corresponding parts.

[0006] According to one embodiment, a method of adjusting a surface of a substrate is described. The method includes comparing a contour of the surface to a reference contour of a reference surface. The method also includes, based upon the comparing, identifying a portion of the surface having a corresponding surface contour that is out of conformance with respect to the reference contour as: (1) a

bump when the corresponding surface contour is proud of the reference contour, otherwise (2) as a divot. The method further comprises bringing the corresponding surface contour of the identified portion into conformance by: depositing a first amount of filler material in a region around the bump, otherwise, depositing a second amount of filler material into the divot.

[0007] According to another embodiment, a method of modifying a mating surface of a substrate is described. The mating surface is arranged to bond with an inlay. The method includes comparing a shape of the mating surface to a shape of a reference surface of the substrate. The reference surface is associated with an external surface of the substrate. The method also includes depositing a filler material on the mating surface such that the mating surface takes on the shape of the reference surface. When the inlay is bonded to the mating surface, an external surface of the inlay is substantially flush with the external surface of the substrate.

[0008] According to a further embodiment, a method of modifying a housing is described. The substrate has a perimeter defined by a lip portion defining dimensions of an opening for accommodating a cover glass. The method includes obtaining dimensional data related to the housing. The method also includes depositing a filler material on a surface of the lip portion so as to decrease the dimensions of the opening in accordance with the dimensional data of the cover glass.

[0009] These and other embodiments will be described in detail below.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The disclosure will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements.

[0011] FIG. 1 shows an internal surface of a housing section of a consumer device having mating surfaces.

[0012] FIGS. 2A-2G show a portion of the housing section of FIG. 1 having a recessed feature undergoing a surface modification process.

[0013] FIGS. 3A-3E show a portion of the housing section of FIG. 1 having a protruding feature undergoing a surface modification process.

[0014] FIGS. 4A-4D show a portion of the housing section of FIG. 1 having a different protruding feature undergoing a surface modification process.

[0015] FIGS. 5A-5E show a portion of the housing section of FIG. 1 having a recessed inlay region undergoing a surface modification process.

[0016] FIG. 6 shows perspective and cross section views of mateable housing sections after undergoing a surface modification process.

[0017] FIGS. 7A-7C show cross section views of a feature undergoing a feature modification process and a surface modification process.

[0018] FIG. 8 shows a flowchart illustrating a method of modifying a surface in accordance with some embodiments.

[0019] FIG. 9 shows a flowchart illustrating another method of modifying a surface in accordance with some embodiments.

[0020] FIG. 10 shows a flowchart illustrating a further method of modifying a surface in accordance with some embodiments.